CLAIMS

1. A bending life predicting method of predicting bending life span of a plurality of wires induced by vibration, at least two points of each of the plurality of wires being constrained, the method comprising the steps of:

a pre-storing step of pre-storing each predicting function representing relationships among atmosphere temperatures, stresses and bending life spans for the plurality of wires;

a setting step of setting the plurality of wires, the atmosphere temperatures, pre-vibration shapes of the plurality of wires, and constraint conditions of the plurality of wires;

a finite element model forming step of forming finite element models of the plurality of wires by using a finite element method;

a vibration analyzing step of calculating natural frequencies for the pre-vibration shapes and calculating stresses in individual finite elements of the finite element models which correspond to the natural frequencies, respectively;

a maximum stress retrieving step of retrieving a maximum stress from the stresses calculated in the vibration analyzing step, for each of the plurality of wires;

a predicting function readout step of reading predicting functions corresponding to the atmosphere temperatures set in

the setting step, respectively;

a bending life predicting step of acquiring a bending life span corresponding to the maximum stress of each of the plurality of wires while referring to the predicting functions read out in the predicting function readout step, and obtaining a shortest bending life span from the bending life spans; and

an output step of outputting the shortest bending life span obtained in the bending life predicting step.

2. The method according to claim 1, wherein in the vibration analyzing step, the plurality of wires are regarded as a wiring structure in which the plurality of wires are bundled, and natural frequencies of the plurality of wires are computed, respectively.

3. The method according to claim 1, wherein the plurality of wires are bundled into a single bundle, and the bundling of the plurality of wires is set as one of the constraint conditions in the setting step.

4. The method according to claim 1, further comprising a position specifying step of specifying a position on the wire corresponding to the shortest bending life span, the output step outputting the position specified by the position specifying step.

5. The method according to claim 1, wherein

in the vibration analyzing step, displacements of finite elements of the finite element models which correspond to the natural frequencies are calculated,

the method includes an interference part predicting step of predicting an interference part on the plurality of wires which is induced by vibrations based on the calculated displacements, and

the output step outputs the predicted interference part.

6. The method according to claim 1, wherein a curve representing a lower confidence interval to a population regression function statistically calculated using the stresses and data on bending endurance life spans that are obtained under a plurality of typical atmosphere temperatures for the plurality of wires, is used for the predicting function.

7. A bending life predicting method of predicting bending life spans of a plurality of electric wires and wire protecting members for protecting the plurality of wires from being bent induced by vibrations, at least two points of each of the plurality of wires being constrained, the method comprising:

a pre-storing step of pre-storing relationships among atmosphere temperatures, stresses and bending life spans for

plurality of wires and the wire protecting member;

a setting step of setting the plurality of wires, the wire protecting member, the atmosphere temperatures, pre-vibration shapes of the plurality of wires and the wire protecting member, and constraint conditions of the plurality of wires and the wire protecting member;

a finite element model forming step of forming finite element models of the plurality of wires and the wire protecting member by using a finite element method;

a vibration analyzing step of calculating natural frequencies for the pre-vibration shapes of the plurality of wire and the wire protecting member, and calculating stresses in individual finite elements of the finite element models which correspond to the natural frequencies, respectively;

a maximum stress retrieving step of retrieving maximum stresses from the stresses calculated in the vibration analyzing step, for each of the plurality of wires and the wire protecting member;

a predicting function readout step of reading predicting functions corresponding to atmosphere temperatures set in the setting step;

a bending life predicting step of acquiring bending life spans corresponding to the maximum stresses of the plurality of wires and the wire protecting member, while referring to the predicting functions read out in the predicting function

readout step, respectively, and obtaining a shortest bending life span from said bending life spans; and

an output step of outputting the shortest bending life span obtained in the bending life predicting step.

8. The method according to claim 7, wherein in the vibration analyzing step, the plurality of wires are regarded as a wiring structure in which the plurality of wires are bundled, and natural frequencies of the plurality of wires are computed, respectively.

9. The method according to claim 7, wherein the plurality of wires are bundled into a single bundle, and the bundling of the plurality of wires is set as one of the constraint conditions in the setting step.

10. The method according to claim 7, further comprising a position specifying step of specifying a position on the wire or the wire protecting member corresponding to the shortest bending life span, the output step outputting the position specified by the position specifying step.

11. The method according to claim 7, wherein

in the vibration analyzing step, displacements of finite elements of the finite element models which correspond to the

natural frequencies are calculated,

the method includes an interference part predicting step of predicting an interference part on the plurality of wires which or the wire protecting member is induced by vibrations based on the calculated displacements, and

the output step outputs the predicted interference part.

12. The method according to claim 7, wherein a curve representing a lower confidence interval to a population regression function statistically calculated using the stresses and data on bending endurance life spans that are obtained under a plurality of typical atmosphere temperatures for the plurality of wires and the wire protecting member, is used for the predicting function.

13. A bending life predicting device for predicting bending life spans of a plurality of wires induced by vibrations, at least two points of each of the plurality of wires being constrained, the device comprising:

a pre-storing unit for pre-storing each predicting function representing relationships among atmosphere temperatures, stresses and bending life spans for the plurality of wires;

a setting unit for setting the plurality for wires, the atmosphere temperatures, pre-vibration shapes of the plurality

of wires, and constraint conditions of the plurality of wires;

a finite element model forming unit for forming finite element models of the plurality of wires by using a finite element method;

a vibration analyzing unit for calculating natural frequencies for the pre-vibration shapes and calculating stresses in individual finite elements of the finite element models which correspond to the natural frequencies, respectively;

a maximum stress retrieving unit for retrieving a maximum stress from the stresses calculated in the vibration analyzing unit, for each of the plurality of wires;

a predicting function readout unit for reading predicting functions corresponding to the atmosphere temperatures set in the setting unit, respectively;

a bending life predicting unit for acquiring a bending life span corresponding to the maximum stress of each of the plurality of wires while referring to the predicting functions read out in the predicting function readout unit, and obtaining a shortest bending life span from the bending life spans; and

an output unit for outputting the shortest bending life span obtained in the bending life predicting unit.

14. The device according to claim 13, wherein

the vibration analyzing unit calculates displacements

of finite elements of the finite element models which correspond to the natural frequencies,

the device includes an interference part predicting unit for predicting an interference part on the plurality of wires which or the wire protecting member is induced by vibrations based on the calculated displacements, and

the output unit outputs the predicted interference part.

15. A computer readable recording medium storing a program for predicting bending life spans of a plurality of wires induced by vibrations, at least two points of each of the plurality of wires being constrained, the program causing a computer to function as:

a pre-storing unit for pre-storing each predicting function representing relationships among atmosphere temperatures, stresses and bending life spans for the plurality of wires;

a setting unit for setting the plurality for wires, the atmosphere temperatures, pre-vibration shapes of the plurality of wires, and constraint conditions of the plurality of wires;

a finite element model forming unit for forming finite element models of the plurality of wires by using a finite element method;

a vibration analyzing unit for calculating natural frequencies for the pre-vibration shapes and calculating

stresses in individual finite elements of the finite element models which correspond to the natural frequencies, respectively;

a maximum stress retrieving unit for retrieving a maximum stress from the stresses calculated in the vibration analyzing unit, for each of the plurality of wires;

a predicting function readout unit for reading predicting functions corresponding to the atmosphere temperatures set in the setting unit, respectively;

a bending life predicting unit for acquiring a bending life span corresponding to the maximum stress of each of the plurality of wires while referring to the predicting functions read out in the predicting function readout unit, and obtaining a shortest bending life span from the bending life spans; and

an output unit for outputting the shortest bending life span obtained in the bending life predicting unit.